

# WISCONSIN FIELD INDICATORS OF SOIL SATURATION LESS THAN 6 INCHES DEEP Version 1.0 Dec. 2005

## INTRODUCTION

This technical guide was created by a technical advisory committee of the Wisconsin Society of Professional Soil Scientists (WSPSS). It was in response to a need for greater uniformity in the interpretive determination of depth to soil saturation for private onsite wastewater dispersal under current state of Wisconsin regulations. These regulations allow mound systems to be installed in soil having a depth to periodic saturation as shallow as 6 inches. Where redoximorphic features occur within 4 inches from the bottom of an A horizon, a special study and interpretive report is required. In most soils, the determination of 6 inch saturation depth puts the interpretation into the A horizon where redoximorphic features are masked by dark soil color. This is approaching the territory of the hydric soil and this guide attempts to provide the link between accepted practices in hydric soil determination and the determination of the 6-inch limitation for the dispersal of domestic wastewater.

The indicators presented in this guide are recommendations from the WSPSS technical advisory committee. Although it is our desire that they be given the attention we think they deserve, these indicators should not be considered irrefutable rules. It is expected that evaluators may encounter exceptions as well as conditions not addressed by this guide. It is also expected that such exceptions and conditions will be revealed and dealt with in a rigorous application of soil science to each site on a case by case basis.

The objective is a technical guide to be used as a reference for the uniform interpretation of the 6-inch depth to soil saturation in Wisconsin soils by the utilization of existing tools and guidelines used by soil scientists in interpreting and evaluating similar soil conditions. It is intended to be used in conjunction with the Field Indicators of Hydric Soils<sup>1</sup>. The approach is presented below:

Premise One: Interpretive determination of depth to soil saturation in an *in situ* (natural) soil profile is based on establishing the location of aquic conditions<sup>2</sup> by identification of redoximorphic features<sup>3</sup>. Where such features may be masked by the dark matrix color of the A horizon, the Field Indicators of Hydric Soils may be used to screen and eliminate those soils that exhibit one or more of the regionally specific indicators used in the Land Resource Region (LRR) where the tested area is located. Hydric soils are expected to become saturated to the surface by the capillary fringe<sup>4</sup>, above the minimum depth allowed for soil dispersal by s. Comm 83.44(3) Wis. Adm. Code and cannot be considered for dispersal of wastewater.

Premise Two: The Field Indicators of Hydric Soils may indicate aquic conditions shallower than 6 inches. Not hydric does not provide the assurance of at least 6 inches of unsaturated soil. Some hydric soil indicators need to be adjusted or calibrated in order to be applied to a depth of six inches.

Premise Three: Calibration of field indicators must be done by the application of sound soil science coupled with an empirical knowledge gained through extensive experience and study of these types of soil conditions. Preparation of this guide has attempted to draw upon individuals with such knowledge and experience.

Premise Four: Depth to aquic conditions is regarded as equivalent to the depth of periodic soil saturation or highest groundwater elevation when applied to Wisconsin POWTS Codes by way of the Interpretive Determination of Depth to Soil Saturation provided by s. Comm 85.60(2) Wis. Adm. Code.

# THE WISCONSIN FIELD INDICATORS OF SOIL SATURATION LESS THAN 6 INCHES DEEP

## ORGANIC DOMINATED SOILS

1. All Histosols
2. All mineral soils having a histic epipedon.
3. All mineral soils having peat, mucky peat, muck, or a mucky modified soil texture within 12 inches of the surface.

Background Reference FIHS Glossary – “peat”, “muck”, “mucky peat”, “mucky modified soil texture”.

## ALL OTHER SOILS

4. **Abundant Gley.** A layer immediately below a surface layer that is 20 percent or more gleyed.

User Note 1: Gley colors are not synonymous with gray colors. Gley colors are those colors that are on the Munsell® gley page. They have a hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more.

User Note 2: Percent gleyed material is by volume. The interior of soil peds must be examined to make this determination.

Background Reference: FIHS-F2 & S4 and Glossary – “gleyed matrix”.

5. **Abundant Depletion.** A layer immediately below a surface layer that has 20 percent or more redox depletions chroma 2 or less.

User Note 1: Redox concentrations may or may not be present, depending on the extent of the depletion.

User Note 2: Percent of depleted material is by volume. The interior of soil peds must be examined to make this determination.

User Note 3: An E horizon may have these characteristics and may be distinguished by examining the underlying horizon. E horizons have a limited thickness, so an underlying horizon may usually be expected within 12 inches below the bottom of an E. If the underlying horizon has a high chroma and no redoximorphic features, then the subject layer is not an indicator of aquic conditions.

User Note 4: Hydraulic gradient, as indicated by topographic slope for many soils, affects the application of this indicator. See Rational for indicators 4 & 5.

Background Reference: FIHS-F3 & S6 and Glossary – “depleted matrix”.

6. **Chroma 3 Sandy Redox.** In sand or loamy sand, a layer immediately below a surface layer that has a matrix with a chroma of 3 or less having 2 percent or more distinct or prominent redox concentrations as soft masses or pore linings.

Background Reference: FIHS-TS5.

7. **Redox Surface.** A zone within the surface layer and within 8 inches of the surface that has discernable redox concentrations as soft masses or pore linings.

User Note 1: These features are most commonly in the form of iron concentrations in the pore linings of fine root channels in loamy and clayey soils.

User Note 2: Redox concentrations in a dark matrix are often difficult to see. The organic matter masks some or all of the iron concentrations that may be present. Careful examination in adequate light is required to see what are often dark reddish brown features in a very dark brown matrix. In some instances, drying of the samples makes the features easier to see, particularly if field conditions offer poor light.

Background Reference: FIHS- F6.

**8. Red Parent Material.** In loamy or clayey parent material with a hue of 7.5YR or redder, a layer immediately below a surface layer with a matrix value 4 or less and chroma 4 or less and having 2 percent or more redox depletions and/or redox concentrations as soft masses or pore linings.

User Note 1: Parent material color may be determined by direct examination of the C horizon or taken from the representative profile description provided in the Soil Survey for the series of the mapping unit at the subject location.

User Note 2: Hydraulic gradient, as indicated by topographic slope for many soils, affects the application of this indicator. See Rational for indicators 4 & 5 regarding the effect of hydraulic gradient on projecting reducing conditions from morphology immediately below a dark surface.

Background Reference: FIHS- TF2.

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## RATIONAL FOR THE WISCONSIN 6-INCH FIELD INDICATORS

**Indicators 1, 2, & 3** Histosols, histic epipedon, and the presence of fibric soil material (peat), hemic soil material (mucky peat), and fibric soil material (muck) are considered the maximum expression of anaerobiosis<sup>3-p.2</sup> and are interpreted as indicators of extremely long-term saturation.

**Indicator 4** [RE: FIHS S4 & F2] Soils having an abundance of gleyed material are saturated for long duration resulting in thorough reduction of iron to Fe+2 (ferrous iron) It is the presence of ferrous iron that is responsible for the greenish colors of gley. Because ferrous iron is soluble, the presence of gley suggests that the processes of translocation are minimal. An absence of iron concentrations within a gleyed zone indicates a stable reducing environment and that periodic, or seasonal, fluctuation of soil saturation does not occur at that depth.

**Indicators 4 & 5** [RE: FIHS F3, F4, F5] Vepraskas<sup>1-p.23</sup> states “The abundance of redox depletions is generally related to how long a soil is reduced”. Although not well correlated to duration of saturation across all types of soils, the abundance of redox depletions does generally indicate the duration of aquic conditions responsible for the creation of redoximorphic features. This relationship between the abundance of redox depletions and the duration of reducing conditions is utilized as a field indicator for some hydric soils.

Depletion feature abundance and proportional volume of depleted soil material directly below a dark surface horizon is used in defining the hydric soil indicators F3, F4 and F5 for loamy and clayey soils in the FIHS Guide<sup>1</sup>. This approach is essentially projecting the expected occurrence of reducing conditions into a dark surface where redoximorphic features are masked by high organic matter content. It appears to be based on the assumption that longer duration of reduction immediately below the dark surface indicates a greater probability of periodic reducing conditions at a higher point within the dark surface. Hence the correlation of percent depletion immediately below the dark surface to height of reducing conditions within the dark surface layer. This approach is applied to loamy and clayey soils in the FIHS Guide and re-applied in this guide for indicators 4 and 5. Vepraskas’ General Rule 3<sup>5</sup> notes that the longer periods of saturation are needed to form similar iron depletions with increasing depth in the soil. In recognition of this observation, no adjustment to percent depletion was made in this guide for a thick dark surface.

This method of interpretation is inherently less precise than direct observation of redoximorphic features. Evaluators need to factor in other properties into the interpretation such as:

- 1) Variations in color (blackness) within the dark surface layer
- 2) Topography and landform with regard to near surface hydrology and the potential degree of fluctuation of water table level within the dark surface.
- 3) Soil properties that effect the strength of expression of redox conditions as redoximorphic features such as pH and parent material.
- 4) Presence and activity of roots and soil macro fauna.

Special regard needs to be given to hydraulic gradient because it has been seen to affect the degree of fluctuation of water table level within the dark surface. In projecting the expected occurrence of reducing conditions into a dark surface, greater hydraulic gradient apparently lessens the height of saturation within the

A horizon. A 20 percent depleted matrix immediately below a dark surface layer (Indicator 5) is applicable to nearly level topography having very a low hydraulic gradient for free water near the surface. For soils having slowly permeable subsoils at locations with discernable slope, a depth of 6 inches to reducing conditions may exist where there is greater than 20 percent depleted matrix immediately below the surface layer. Intense examination of the lower portion of the A horizon for the presence of root pore lining iron concentrations (Indicator 7) is recommended in conjunction with examination of the entire topo-drainage sequence.

**Indicator 6** [RE: FIHS TS5] The underlying assumption is that the exposed primary base color of sandy soil materials after the iron has been removed has a chroma of 3 or less. FIHS TS5 requires the presence of at least 2 percent distinct or prominent redox concentrations as soft masses or pore linings to be present. This presence of redox concentrations was incorporated into the FIHS indicator. However, it should be recognized that some depleted matrices may have had virtually all iron removed immediately below a surface layer and have no iron concentrations in this zone. These criteria were incorporated by the FIHS Guide to distinguish the depleted matrix from E and calcic horizons. In Wisconsin, calcic horizons are not found close to the surface and an E horizon can be identified by the full profile examination recommended in User Note\_2 for Indicator 5. A layer having a low chroma matrix located between a dark surface and distinct or prominent redox concentrations should be regarded as indicative of soil saturation shallower than 6 inches. As in most soil morphology interpretations, this needs to be correlated with landscape hydrology as revealed by examination of the topo-drainage sequence (catina). An evaluator may have the difficult task of discriminating among a redoximorphic depletion, an E horizon, and low chroma sandy parent material. This should be done by examination of the topo-drainage sequence, where possible, rather than focusing on soil morphology at a single location.

**Indicator 7** Iron concentrations in the pore linings of fine root channels are commonly observed in the lower portions of the Ap horizon of loamy and clayey soils. The limit to their detection within the matrix is near value 3 / chroma 2, but they can be observed in a somewhat darker matrix under favorable light and/or in air-dried samples. They may be interpreted as indicators of reducing conditions of significant duration and it may be assumed that aquic conditions exist for shorter periods at a depth slightly higher than the shallowest observation of these features. This indicator being a direct observation of redoximorphic features, it is inherently more precise than the projection approach used by indicators 4 and 5 and may take precedence over them. The identification of a “zone” is important because localized pockets or lenses of platy structure may exhibit these features in isolation from a matrix having three-dimensional structure.

**Indicator 8** [RE: FIHS TF2] This indicator has special application to the reddish clay loam materials of the Kewaunee till in northeastern Wisconsin, but is applicable to other regions in the state where parent material color indicates the dominance of stable iron minerals. These minerals are relatively stable dehydrated ferric oxides that tend to produce soil colors having a hue of 7.5YR or redder within the solum. The thermodynamic stability of these minerals makes them resistant to electrochemical reduction. As a result, stronger reducing conditions and/or longer duration of reducing conditions are required to produce redoximorphic features. Evaluation calls for a lesser expression in contrast and abundance of redoximorphic features when interpreting aquic conditions in these soils. Regarding matrix color: In moderately well drained soils, the upper limit of aquic conditions may be detected by a relatively higher matrix chroma in the upper portion of the B horizon. This interpretation is not available where aquic conditions approach the bottom of the A horizon. However, examination of an adjacent moderately well drained soil might allow extrapolation of indicative soil color to a lower point on the topo-drainage sequence. Where it can be performed, such extrapolation is preferable to relying on the universal “4 or less” matrix color of indicator 8.

A Comment on pH and Soil Reaction: High pH tends to stabilize ferric iron compounds and make them more resistant to electrochemical reduction. Attention therefore must be given to soil reaction in interpreting aquic conditions by the expression of redox morphology. It is recommended that the 2 percent or more redox depletions and/or redox concentrations as soft masses or pore linings of Indicator 8 be applied to any soil layer having a USDA soil reaction class of slightly or moderately alkaline. This corresponds to a soil pH range between 7.4 and 8.4. The soil reaction class may be taken from the representative profile description provided in the Soil Survey for the series of the mapping unit at the subject location.

**Summary:** The WSPSS Technical Advisory Committee wishes to emphasize that a site evaluation be done by examination of the topo-drainage sequence, where possible, rather than focusing on soil morphology at a single location or point on the landform. Make preparations to access neighboring parcels were necessary to do this. In determining a depth to soil saturation, one is predicting conditions at a point along the landscape hydrology. Interpretation of soil redox morphology is a critical part in this evaluation. Use it, and all other available information, to get the big picture of the near-surface hydrology for the entire landscape, then zoom in on the test area.

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<sup>1</sup> United States Department of Agriculture, Natural Resources Conservation Service. 2003. Field Indicators of Hydric Soils in the United States, Ver. 5.01. G.W. Hurt, P.M. Whited, and R.F. Pringle (eds.).

<sup>2</sup> Vepraskas, M.J. 1996. Redoximorphic Features for Identifying Aquic Conditions. Tech. Bulletin 301. North Carolina Ag. Research Service, North Carolina State Univ., Raleigh, NC.

<sup>3</sup> s. Comm 85.30(2)(a) Wisconsin Administrative Code; Jan 2004 No. 577

<sup>4</sup> Vepraskas, M. J. and S. W. Sprecher. 1997. Overview of Aquic Conditions and Hydric Soils. In M.J. Vepraskas and S.W. Sprecher (eds) Aquic Conditions and Hydric Soils: The Problem Soils. SSSA Spec. Publ. 50. SSSA, Madison, WI

<sup>5</sup> Vepraskas, M. J. Theoretical Background and Development of Redoximorphic Features. In: Redoximorphic Features Conference of the Minnesota Onsite Wastewater Conference. March 23, 2005, Duluth, MN. (unpublished presentation).